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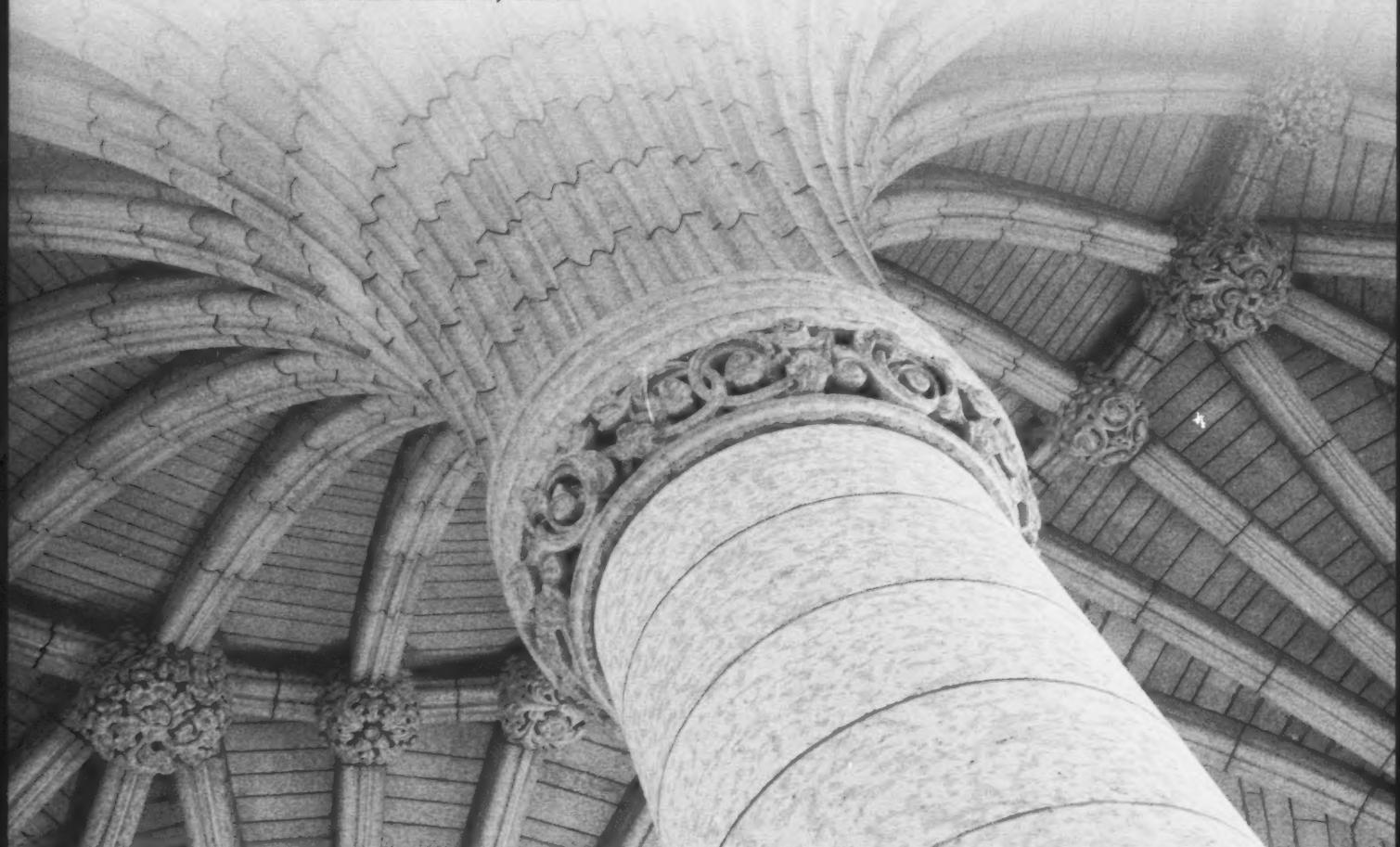
BETTER BUILDINGS FOR A LOW-CARBON FUTURE

Report of the Standing Committee on Environment and Sustainable Development

Deborah Schulte, Chair



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42nd PARLIAMENT, 1st SESSION

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BETTER BUILDINGS FOR A LOW-CARBON FUTURE

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Deborah Schulte
Chair

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NOTICE TO READER

Reports from committees presented to the House of Commons

Presenting a report to the House is the way a committee makes public its findings and recommendations on a particular topic. Substantive reports on a subject-matter study usually contain a synopsis of the testimony heard, the recommendations made by the committee, as well as the reasons for those recommendations.

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THE STANDING COMMITTEE ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

has the honour to present its

SEVENTEENTH REPORT

Pursuant to its mandate under Standing Order 108(2), the Committee has studied Clean Growth and Climate Change in Canada: Built Environment and has agreed to report the following:

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SUMMARY

Canada's built environment – the collective of Canadians' residences, commercial buildings, and institutional buildings – is responsible for approximately 12% of the nation's total greenhouse gas emissions. The majority of these emissions result from the heating of water and buildings. The Pan-Canadian Framework on Clean Growth and Climate Change proposed new actions for the federal government to reduce greenhouse gas (GHG) emissions from the built environment, in support of Canada's international commitments.

The Standing Committee on Environment and Sustainable Development conducted its study of the built environment to determine how the federal government can help to further accelerate the transition to more energy-efficient buildings that emit fewer greenhouse gases. The Committee heard from home builders, territorial government officials, representatives from voluntary building standards organizations, and federal government officials, among others.

The federal government leads the development and regular updating of national model codes. A core objective of the national building codes should be added to reflect the importance of these codes in increasing energy efficiency and decreasing GHG emissions for the built environment.

The Committee is encouraged that, for the first time, a model energy code will provide guidance to those retrofitting and improving the energy efficiency of existing buildings. To target the most effective emissions reduction opportunities, a national strategy for energy retrofits of existing buildings should be developed, which reflects regional differences in building age and type, climate, and heating fuel type. Once energy retrofits are completed, the effectiveness of this work at reducing energy usage and GHG emissions should be verified, and the federal government should develop tools for this purpose.

The Committee looks forward to the publication of the next version of the national model energy code for new buildings, which will be tiered and will facilitate provinces and territories to gradually achieve net-zero energy ready codes by 2030. To allow for the implementation of net-zero energy ready codes, a skilled labour transition will be required. Building operator and inspector training is important as energy-efficient building systems become increasingly available.

To make smart decisions, Canadians need information tools to easily estimate the impact of behaviour changes and retrofits on their buildings' energy usage and embodied carbon. As well, more Canadians should be made aware of the federal incentives available to them

to buy, build, and renovate energy-efficient homes. Further incentives and a streamlined regulatory environment are recommended to encourage the early adoption of onsite renewable energy generation and green building techniques and technologies.

The value of building science research, development, and demonstration funded by the federal government was mentioned by numerous private and public sector witnesses during this study. Building science initiatives should be increased, particularly for the North. Building standards specifically adapted to the North should be developed cooperatively, including with Indigenous governments and communities, to address the North's unique challenges.

The federal government must lead by example. High energy efficiency standards should be demanded when the federal government acquires new buildings or rental space. Departments and agencies responsible for federally-owned buildings should spur on the adoption of building innovations by developing and implementing multi-year energy retrofit strategies for their buildings.

LIST OF RECOMMENDATIONS

As a result of their deliberations committees may make recommendations which they include in their reports for the consideration of the House of Commons or the Government. Recommendations related to this study are listed below.

Recommendation 1

The Committee recommends that the National Research Council, working with the Canadian Commission on Building and Fire Codes, publish the national model energy codes for both new and existing buildings as soon as possible, and for existing buildings no later than fiscal year 2022-23. 19

Recommendation 2

The Committee recommends that the National Research Council work with the Canadian Commission on Building and Fire Codes to add a new core objective to the national model codes that clearly identifies the importance of increasing energy efficiency and decreasing greenhouse gas emissions in Canada's buildings. 20

Recommendation 3

The Committee requests that Global Affairs Canada and Finance Canada respond to this report with a full description of how recent trade agreements signed by Canada have reduced tariffs on products and services that are specifically relevant to low-carbon building materials. 21

Recommendation 4

The Committee recommends that Employment and Social Development Canada ensure that programs exist or are established to address the labour transition required so that skilled personnel are available to implement net-zero energy ready codes. 22

Recommendation 5

The Committee recommends that Natural Resources Canada, the National Research Council, and the Canada Mortgage and Housing Corporation work together to develop a national strategy for energy retrofits of existing buildings that reflects regional differences and targets the most effective emissions reduction opportunities. 22

Recommendation 6

The Committee recommends that Infrastructure Canada work to provide significant funding in order to accelerate energy retrofits of commercial, institutional, and multi-residential buildings in the public and private sectors, such as through the Canada Infrastructure Bank. 23

Recommendation 7

The Committee recommends that Natural Resources Canada, in collaboration with the National Research Council and the Canada Mortgage and Housing Corporation, develop guidance and tools to support verification of the effectiveness of completed energy retrofits. 23

Recommendation 8

The Committee recommends that the federal government create or adopt a measurement tool to take into account the net carbon emissions avoided through adaptive reuse of existing buildings. 25

Recommendation 9

The Committee recommends that, as the federal government takes steps to recognize the value of embedded carbon in existing construction, it should take into account the unique characteristics of heritage buildings and the public interest in their protection. 25

Recommendation 10

The Committee recommends that Natural Resources Canada, the National Research Council, and Environment and Climate Change Canada include building operator and building inspector training as part of federal funding, research, and incentive programs aimed at improving energy efficiency and reducing greenhouse gas emissions from the built environment. 27

Recommendation 11

The Committee recommends that Natural Resources Canada, in collaboration with the National Research Council, invest in methods (e.g. apps, web-based programs) through which building and home owners can obtain easily-understood information about their estimated energy usage and carbon

emissions, and to compare the economic and emissions impacts of various energy-efficiency retrofits. 29

Recommendation 12

The Committee recommends that the federal government further invest in research, development, and demonstration in building science. 30

Recommendation 13

The Committee recommends that the Canada Mortgage and Housing Corporation work with its partners to more broadly promote the incentives available for buying, building, and renovating energy-efficient homes, prior to the point of financing. 31

Recommendation 14

The Committee recommends that Natural Resources Canada and the National Research Council work with, and encourage, provincial/territorial, municipal, and industry partners to streamline the regulatory environment in order to encourage the early adoption of onsite renewable energy generation and green building techniques and technologies. 33

Recommendation 15

The Committee recommends that Natural Resources Canada, Finance Canada, Infrastructure Canada, and the Canada Mortgage and Housing Corporation identify and implement effective financial incentives to encourage on-site renewable energy generation and net-zero energy ready building construction (e.g. a federally-backed mortgage rate reduction, Canada Infrastructure Bank funding, insurance incentives, or programs similar to the U.S. renewable energy tax credits or U.S. tax credits for home builders). 33

Recommendation 16

The Committee requests that the federal government focus more attention on its Greening Government Strategy and report back to the Committee on its progress by the end of 2018. 34

Recommendation 17

The Committee recommends that Public Services and Procurement Canada and the Treasury Board of Canada Secretariat work with all other federal departments and agencies to demand higher energy efficiency standards (e.g. LEED, BOMA BEST) when procuring rental space and new buildings. 35

Recommendation 18

The Committee recommends that Public Services and Procurement Canada and the Treasury Board of Canada Secretariat require all federal custodian departments and agencies to develop and implement multi-year energy retrofit strategies for their respective portfolios of existing federally-owned buildings. 35

Recommendation 19

The Committee recommends that the federal government, when making federal infrastructure procurement decisions, consider including full life cycle analyses that address carbon emissions and storage resulting from the infrastructure's materials, construction, operation, and de-commissioning..... 35

Recommendation 20

The Committee recommends that Natural Resources Canada and the National Research Council work with Indigenous governments and communities, territorial and affected provincial governments, and industry to invest in building science and clean energy generation research, development, demonstration, and post-construction monitoring in the Canadian North. 37

Recommendation 21

The Committee recommends that Natural Resources Canada and the National Research Council work with Indigenous governments and communities and territorial and affected provincial governments to develop building standards specifically adapted to the Canadian North. 37

LIST OF OBSERVATIONS

Observation 1

The Committee encourages the Canadian Commission on Building and Fire Codes to adjust the national model codes to ensure that roofs are built to withstand the minimal added weight of possible future solar energy system installations. 20

Observation 2

The Committee encourages the Canadian Commission on Building and Fire Codes to permit variations from standard requirements in the national model codes, if certified by building sciences engineers, in order to facilitate the use of innovative technologies and building approaches. 20

Observation 3

The Committee encourages Canadian industry to diversify and innovate in order to provide energy-efficient building components and materials..... 21

Observation 4

The Committee encourages relevant trades institutions, such as the Heating, Refrigeration and Air Conditioning Institute of Canada, and building inspectors to prioritize training that will prepare personnel to implement net zero energy ready codes and increasingly sophisticated building systems. 22

Observation 5

The Committee encourages provinces and territories to require the inclusion of building energy labelling information in real estate listings, to promote consumer awareness of energy-efficient building practices..... 29

BETTER BUILDINGS FOR A LOW-CARBON FUTURE

A. BACKGROUND

1. Context of the Study

On 1 February 2018, the Standing Committee on Environment and Sustainable Development (the Committee) agreed to conduct a review of Clean Growth and Climate Change in Canada and that, in order to accomplish this review, it would study several focused areas and report to the House separately on each of them. The contribution of the buildings sector to Canada's greenhouse gases emissions (Figure 1) led to the Committee starting its study with this topic.[1]

The Committee began its study of the built environment on 6 February 2018. The study was carried out over four meetings, during which Committee members heard from 19 witnesses and received five written briefs from witnesses.

The members of the Committee would like to thank each of the witnesses for contributing to the Committee's work. Their testimony has been presented in this report by theme. The Committee has included recommendations in this report addressed to the federal government and its agencies to potentially further accelerate a smooth transformation to more energy-efficient buildings in Canada, with the goals of reducing greenhouse gas (GHG) emissions while encouraging economic growth in the green building sector.

2. Emissions from Canada's Built Environment

Canada's built environment consists of approximately 14.1 million households[2] and 482,000 commercial or institutional buildings.[3] In 2015, buildings in Canada accounted for 12% of total greenhouse gas (GHG) emissions (see Figure 1), or 17% if emissions from

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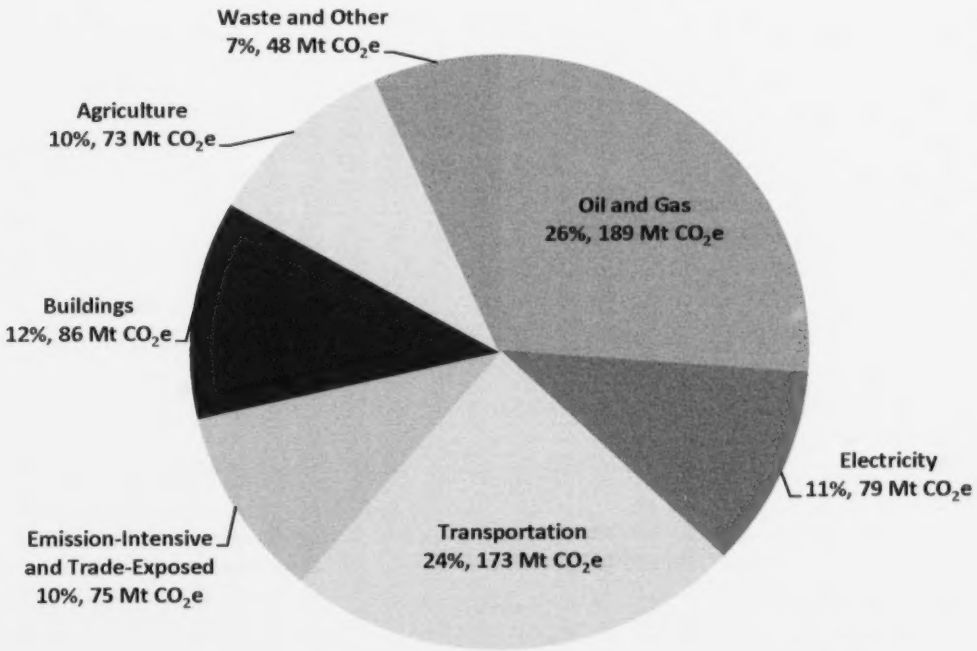
1 House of Commons, Standing Committee on Environment and Sustainable Development (ENVI), *Minutes of Proceedings*, 1 February 2018.

2 Natural Resources Canada, Office of Energy Efficiency, Statistics and Analysis, National Energy Use Database, "Comprehensive Energy Use Database, Residential Sector – Table 20."

3 Statistics Canada, The Daily, *Survey of Commercial and Institutional Energy Use, 2014*.

generating the electricity used in buildings are included. The percentage of Canada's GHG emissions from the building sector has remained approximately the same since 1990.[4]

Figure 1 – Canada: Greenhouse Gas Emission Breakdown by Economic Sector, 2015



Note: "Mt CO_2e" means megatonnes of carbon dioxide equivalent. Emissions from generating electricity are shown separately from the economic sectors that subsequently used the electricity.

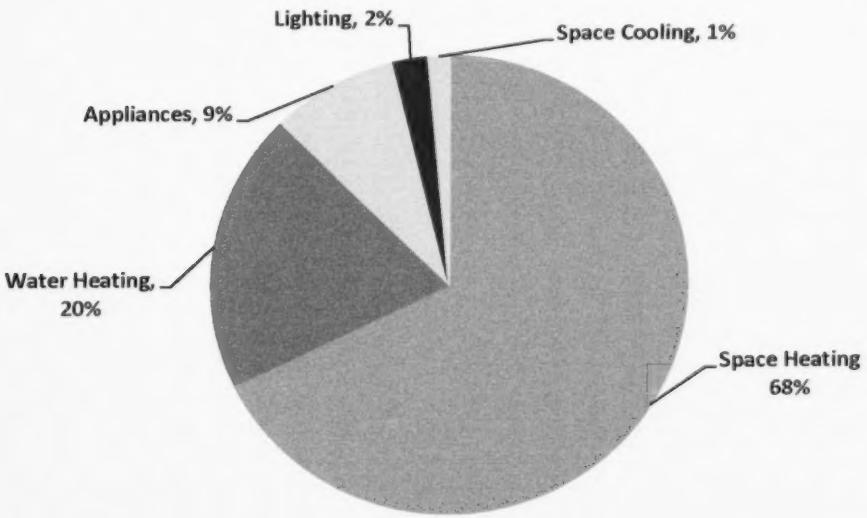
Source: Figure prepared by the Library of Parliament using data obtained from Environment and Climate Change Canada Data, *B-Tables-Canadian-Economic-Sector-Canada*.

By understanding how energy is used in buildings, Canada can target its efficiency improvements in order to have the greatest impact. In 2015, space heating accounted for the largest amount of energy consumed by Canadian households at 68% of total energy

4 Environment Canada, 2014, Canada's Emission Trends, *Historical Greenhouse Gas Emissions by Sector*.

consumed; it was followed by water heating (20%), appliances (9%), lighting (2%) and space cooling (1%) (see Figure 2).[5] Although there are regional variations, these ratios are, for the most part, representative of energy consumption patterns across Canada.

Figure 2 – Percentage of Energy End-Use in Households Canada, 2015 (Petajoules)



Note: Petajoule is a measure of energy.

Source: Figure was prepared by the Library of Parliament using data obtained from Natural Resources Canada, *Comprehensive Energy Use Database*, Residential Sector.

3. Variation in Emissions from Residential and Non-Residential Buildings Across Canada

Residential buildings account for 59% of total emissions – including electricity-related emissions – in the buildings sector, while commercial and institutional buildings account for the remaining 41%.[6] Non-electricity emissions are mostly attributed to natural gas,

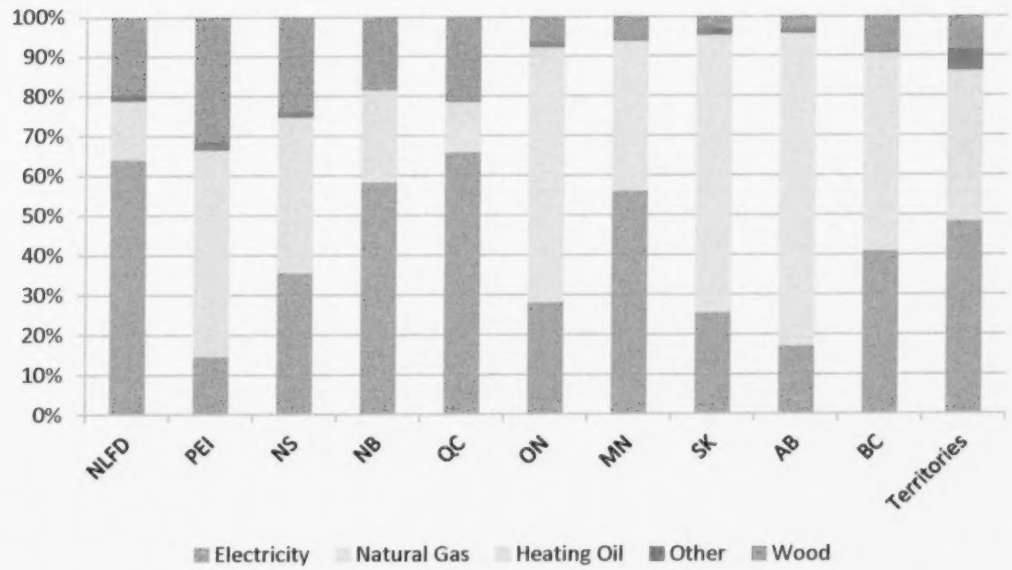
5 Natural Resources Canada, Office of Energy Efficiency, *Comprehensive Energy Use Database*.

6 Natural Resources Canada, Office of Energy Efficiency, *Comprehensive Energy Use Database*.

followed to a lesser extent by heating oil and wood burning. Emissions are also linked to leaks in refrigeration and air conditioning systems.

The heating sources of households vary across Canada (as shown in Figure 3) depending on access to natural gas distribution networks.

Figure 3 – Percentage of Energy Used by Source in Residential Buildings in Canada, 2015 (Petajoules)

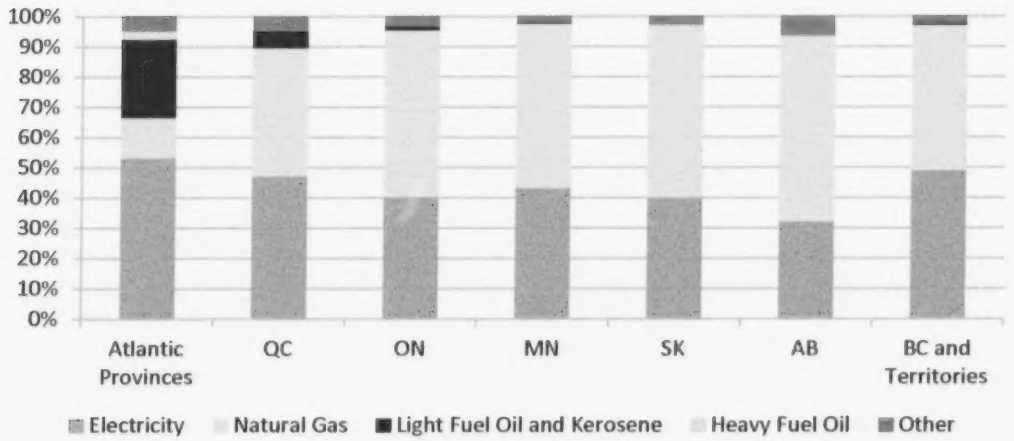


Note: Petajoule is a measure of energy.

Source: Figure was prepared by the Library of Parliament using data obtained from Natural Resources Canada, *Comprehensive Energy Use Database*, Residential Sector.

Non-residential buildings differ from residential buildings in the proportion of sources of energy used, even within the same province or territory. This difference can be seen by comparing Figure 3 (residential buildings) to Figure 4 (non-residential buildings).

Figure 4 – Percentage of Energy Used by Source in Non-Residential Buildings in Canada, 2015 (Petajoules)



Note: Petajoule is a measure of energy.

Source: Figure was prepared by the Library of Parliament using data obtained from Natural Resources Canada, *Comprehensive Energy Use Database*, Residential Sector.

The provincial and territorial variation in heating fuel source, source of electricity generation, population density, building types, and also climate, results in differences in GHG emissions. Therefore, the GHG emissions that can be avoided through increasing renewable energy generation and highly energy-efficient buildings also vary between provinces and territories. These data show the need to transition to less carbon-intensive energy sources in Canada in order to reduce GHG emissions. The Committee notes that the Standing Committee on Natural Resources recently tabled a report that addresses low-carbon energy access.[7]

4. Jurisdiction for Building Construction

Under Canada's Constitution, the provinces and territories have jurisdiction over establishing building construction codes.[8] To leverage federal building research capacity, and to promote national consistency, the federal government participates in the

7 House of Commons Standing Committee on Natural Resources, *Strategic Electricity Inter-ties*, Seventh Report, 1st Session, 42nd Parliament, December 2017.

8 National Research Council Canada, *Canada's national model codes development system*.

development of construction standards in the form of national model building codes.[9] These codes are developed through close consultation with provinces, territories, and industry by the Canadian Commission on Building and Fire Codes, with support from the National Research Council of Canada. There are four model codes:[10]

- The *National Building Code of Canada* addresses the design and construction of new buildings and the substantial renovation of existing buildings (last updated in 2015).
- The *National Energy Code of Canada for Buildings* sets out technical requirements for the energy-efficient design and construction of new buildings (last updated in 2017).
- The *National Fire Code of Canada* (last updated in 2015).
- The *National Plumbing Code of Canada* (last updated in 2015).

Given that the provinces have jurisdiction over construction, these national model codes serve as recommendations only. The requirements they contain are not legally binding unless they are set out in provincial laws and regulations. The provinces and territories and, in certain cases, municipalities,[11] may incorporate the requirements of the national model codes in whole or in part, and with or without amendments. The provinces and territories also have the option of adopting new requirements to meet specific needs.

5. Pan-Canadian Framework on Clean Growth and Climate Change

The *Pan-Canadian Framework on Clean Growth and Climate Change*[12] (Pan-Canadian Framework) lays out federal, provincial, and territorial actions to meet Canada's commitments under the *Paris Agreement*[13] to reduce GHG emissions to 30% below 2005 levels by the year 2030. The Pan-Canadian Framework is built on four pillars: 1) carbon pricing; 2) complementary mitigation actions in all sectors of the economy

9 National Research Council Canada, *Canada's national model codes development system*.

10 National Research Council Canada, *Codes Canada publications*.

11 Some provinces delegate, in whole or in part, the power to oversee construction standards to municipalities.

12 Governments of Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Alberta, British Columbia, Yukon, Northwest Territories, Nunavut, and Canada. 2016. *Pan-Canadian Framework on Clean Growth and Climate Change*.

13 Canada and 194 other countries party to the United Nations Framework Convention on Climate Change reached the *Paris Agreement* on December 12, 2015. Canada ratified the *Paris Agreement* on October 5, 2016.

(including the built environment); 3) adaptation and resilience; and 4) clean technology, innovation and jobs.

In relation to the built environment, the Pan-Canadian Framework proposes the following new actions for the federal government to reduce GHG emissions:

- work with provinces and territories to develop increasingly stringent national model building codes, starting in 2020, with the goal of a "net-zero energy ready"[14] model building code for new buildings adopted by provinces and territories by 2030;
- work with provinces and territories to develop a model retrofit building code for energy efficiency improvements when renovating existing buildings before 2023;
- work with provinces and territories to require labelling of building energy use by as early as 2019;
- set highly efficient new standards for heating equipment and other key appliances; and
- support Indigenous communities with energy-efficient building standards and to incorporate energy efficiency in building renovation programs.

The *First Annual Synthesis Report on the Status of Implementation*[15] of the Pan-Canadian Framework was released in December 2017. The report notes that federal, provincial, and territorial Ministers of Energy collaborated on the August 2017 *Canada's Buildings Strategy*.[16] Natural Resources Canada partnered with construction companies and organizations to demonstrate net-zero energy ready homes. The feasibility of "net-zero" institutional, commercial, and residential buildings has been demonstrated in Canada, with the completion of the first buildings of these types in the last few years.[17]

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14 Natural Resources Canada defines a Net-Zero Energy home as one that produces at least as much energy as it consumes on an annual basis. Natural Resources Canada, *Net Zero Energy (NZE) Housing*.

15 *First Annual Synthesis Report on the Status of Implementation*, December 2017.

16 Energy and Mines Ministers' Conference, *Canada's Buildings Strategy*, August 2017.

17 The first net-zero institutional building was built in 2014 in Quebec; the first net-zero commercial office building opened in 2015 in Alberta; and net-zero homes have been sold in multiple provinces (Energy and Mines Ministers' Conference, *Build Smart - Canada's Buildings Strategy*, St. Andrews by-the-Sea, New Brunswick, August 2017).

B. FINDINGS AND SOLUTIONS

1. Context of Energy Use in Canada's Built Environment

Officials from Natural Resources Canada, the National Research Council, and Environment and Climate Change Canada testified before the Committee to set the context for the study. Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Natural Resources Canada, explained that Canada is a fairly high energy user due to its cold climate and its relatively large homes to heat. In comparison to other G20 nations, Canada's energy use per square foot (or per unit of Gross Domestic Product) is relatively high.[18] Since the vast majority of the energy used in buildings is for heating[19] (space heating and water heating), heating is a priority area to target with efficiency and innovation. Mr. DesRosiers explained that, in reducing emissions from building heating, there are two main strategies: 1) reduce emissions for the energy source used to produce the heat; and 2) improve the building envelope to reduce heat loss to the outside.[20] Mr. DesRosiers noted that a complication in addressing building efficiency across Canada is that the country has six climate zones, a variety of energy sources, and a variety of building types and ages.[21]

2. Implementation of Building Efficiency Improvements through Model Codes

a. Code Development Cycle

The Committee heard that the preparation of each version of the national model codes generally works on a five-year cycle, with much consultation, review, and cost-benefit analysis prior to the publishing of new codes.[22] Consensus is sought from provinces and territories before proposed changes are made to the national model codes. Although

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18 ENVI, *Evidence*, 6 February 2018, 1110 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

19 ENVI, *Evidence*, 6 February 2018, 1110 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

20 ENVI, *Evidence*, 6 February 2018, 1110 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

21 ENVI, *Evidence*, 6 February 2018, 1110 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

22 ENVI, *Evidence*, 6 February 2018, 1140 (Philip Rizcallah, Director, Building Regulations, National Research Council of Canada).

this process takes time, representatives from the National Research Council (NRC) explained that this ensures that the national model code is feasible to be adopted by provincial and territorial jurisdictions. Sarah Stinson, Director of the Buildings and Industry Division at the Office of Energy Efficiency, added that consultation with provinces, territories, and industry during code development enables the building industry and code inspectors to become familiar with proposed changes and ready to implement them.[23]

During the code development cycle, NRC provides analysis of the science, social impact, and economic impact of proposed code modifications.[24] NRC's pilot projects, techno-economic assessments, and industry best practice guides and tools are designed to increase uptake in the marketplace of the national model codes and of new technologies that support the codes.[25]

b. Existing Buildings

Currently, the *National Energy Code for Buildings* only applies to new buildings. Because 75% of 2030's anticipated building stock is already built, while only 25% remains to be built, the improvements to codes for new buildings would only impact 25% of 2030's building stock. GHG emissions could be reduced from existing buildings through energy retrofitting,[26] for which there is no national model code.[27]

To address the need to reduce emissions from existing buildings, the NRC is creating a technical guide for existing buildings in code language, allowing provinces to decide if and how to apply it.[28] For example, a jurisdiction may request that, at the point of a planned major building renovation (i.e. "down to the studs"[29]), energy efficiency be

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23 ENVI, *Evidence*, 6 February 2018, 1155 (Sarah Stinson, Director, Buildings and Industry Division, Office of Energy Efficiency, Energy Sector, Department of Natural Resources).

24 ENVI, *Evidence*, 6 February 2018, 1135 (Richard Tremblay, Director General, Construction, National Research Council of Canada).

25 ENVI, *Evidence*, 6 February 2018, 1125 (Richard Tremblay, Director General, Construction, National Research Council of Canada).

26 ENVI, *Evidence*, 6 February 2018, 1110 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

27 ENVI, *Evidence*, 6 February 2018, 1145 (Philip Rizcallah, Director, Building Regulations, National Research Council of Canada).

28 ENVI, *Evidence*, 6 February 2018, 1145 (Philip Rizcallah, Director, Building Regulations, National Research Council of Canada).

29 ENVI, *Evidence*, 15 February 2018, 1200 (Thomas Hewitt, President, Netzero Construction).

improved at the same time. Such a policy or regulation would make the most of the few opportunities in the life cycle of a building to conduct deep energy retrofits that could realize 20-40% energy use reduction.[30]

c. Tiered National Model Energy Code for New Buildings

In order to accommodate differing provincial energy efficiency baselines, and to facilitate provinces and territories incorporating increasingly stringent standards into their building codes, the next version of the *National Energy Code for Buildings* will be structured in tiers. The tiers will facilitate gradual increases by provinces to the energy efficiency standards of their building codes from their respective starting points, with the objective of reaching net-zero energy ready for new buildings by 2030.[31]

The publication of a tiered *National Energy Code for Buildings* would clearly communicate to industry and consumers the anticipated changes as efficiency standards improve in a given jurisdiction. This tiered approach with increasing efficiency was endorsed by Thomas Hewitt, President of Netzero Construction, because it would ensure sufficient time to adapt Canada's building supply inventory.[32] Mr. Hewitt believes that increasing the stringency of the building code and standards for residential home components will drive increased domestic supply of energy-efficient building components and decrease their cost.[33]

d. Timing of the Publication and Implementation of New Model Codes

In conducting this study, the Committee was interested in how building code changes might be accelerated in order to drive energy efficiency in the built environment. Mr. Tremblay clarified that the Pan-Canadian Framework states that work on the increasingly stringent energy codes for new construction is to start in 2020. He specified that the NRC's objective is to have a revised model energy code for new construction published by fiscal year 2022-2023.[34]

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30 ENVI, *Evidence*, 13 February 2018, 1120 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

31 ENVI, *Evidence*, 6 February 2018, 1140 (Philip Rizcallah, Director, Building Regulations, National Research Council of Canada).

32 ENVI, *Evidence*, 15 February 2018, 1225 (Thomas Hewitt, President, Netzero Construction).

33 ENVI, *Evidence*, 15 February 2018, 1145 (Thomas Hewitt, President, Netzero Construction).

34 ENVI, *Evidence*, 6 February 2018, 1130 (Richard Tremblay, Director General, Construction, National Research Council of Canada).

When asked about accelerating the timeline for publishing net-zero energy ready national model codes for new buildings, with the goal of adoption by provinces by 2030, Mr. Rizcallah advised that this is already an ambitious timeline. He explained that it would not serve provinces or industry well to accelerate more stringent codes without the necessary technology and capacity in place to implement them.[35] Bijan Mannani, President of Landmark Homes Canada concurred:

> I think we need to have a gradual process of introducing higher energy efficiency requirements. That target needs to be gradual, with a specific schedule and timeline identified in order for the whole industry to gear up with business partners—from builders to HVAC [heating, ventilation, and air conditioning] to windows to building envelope installation—where everything goes hand in hand.[36]

Reflecting the importance of accelerating the transition to highly energy-efficient buildings in Canada, and of providing an early signal to the market:

Recommendation 1

The Committee recommends that the National Research Council, working with the Canadian Commission on Building and Fire Codes, publish the national model energy codes for both new and existing buildings as soon as possible, and for existing buildings no later than fiscal year 2022-23.

e. Specific Improvements to the Model Codes

A number of witnesses identified areas within the national model codes that could be improved.[37] For example, Michael Giroux, President of the Canadian Wood Council, noted to the Committee that the stated objectives of the national model codes are missing any core objective related to sustainability, efficiency, or carbon emissions.[38] Rather, the stated objectives only include reducing energy and water use, ensuring fire and structural protection and safety, and ensuring health and accessibility. To address this perceived gap:

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35 ENVI, *Evidence*, 6 February 2018, 1155 (Philip Rizcallah, Director, Building Regulations, National Research Council of Canada).

36 ENVI, *Evidence*, 13 February 2018, 1110 (Bijan Mannani, President, Landmark Homes Canada).

37 ENVI, *Evidence*, 13 February 2018, 1125 (Michael Giroux, President, Canadian Wood Council); ENVI, *Evidence*, 15 February 2018, 1130 (Thomas Hewitt, President, Netzero Construction); ENVI, *Evidence*, 13 February 2018, 1140 (Michael McSweeney, President and Chief Executive Officer, Cement Association of Canada).

38 ENVI, *Evidence*, 13 February 2018, 1125 (Michael Giroux, President, Canadian Wood Council).

Recommendation 2

The Committee recommends that the National Research Council work with the Canadian Commission on Building and Fire Codes to add a new core objective to the national model codes that clearly identifies the importance of increasing energy efficiency and decreasing greenhouse gas emissions in Canada's buildings.

Michael McSweeney, President and Chief Executive Officer of the Cement Association of Canada, warned that building codes being maintained as the minimum standards can impede low-carbon and clean technology innovation.[39] Mr. Hewitt specified some areas of the national model codes that could be changed to facilitate the installation of innovative clean technologies in homes. He recommended that the national model codes be adjusted to ensure that roofs are built to withstand the added pressure of possible future solar energy system installations, which Mr. Hewitt estimated to be 3 to 5 pounds per square foot (14.7 kilograms force per square metre), or an increase of no more than 10% from the current standard.[40] To encourage the use of non-standard innovative technologies and building approaches, Mr. Hewitt also recommended that the national model codes permit variations from standard requirements if certified by building sciences engineers (such an exception is already in place for variations certified by structural engineers).[41] As a result:

Observation 1

The Committee encourages the Canadian Commission on Building and Fire Codes to adjust the national model codes to ensure that roofs are built to withstand the minimal added weight of possible future solar energy system installations.

Observation 2

The Committee encourages the Canadian Commission on Building and Fire Codes to permit variations from standard requirements in the national model codes, if certified by building sciences engineers, in order to facilitate the use of innovative technologies and building approaches.

Mr. Hewitt also noted that he imports his high efficiency windows and heat recovery ventilators from Europe because they are much more efficient yet cheaper than what can be sourced currently from North America. Because higher European standards make

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39 ENVI, *Evidence*, 13 February 2018, 1140 (Michael McSweeney, President and Chief Executive Officer, Cement Association of Canada).

40 ENVI, *Evidence*, 15 February 2018, 1225 (Thomas Hewitt, President, Netzero Construction).

41 ENVI, *Evidence*, 15 February 2018, 1130 (Thomas Hewitt, President, Netzero Construction).

such components "standard" and common there, as opposed to in Canada where they are "custom" and rarer, Mr. Hewitt deduced that higher standards over time result in lower costs per unit of high-efficiency building materials/components.

Recommendation 3

The Committee requests that Global Affairs Canada and Finance Canada respond to this report with a full description of how recent trade agreements signed by Canada have reduced tariffs on products and services that are specifically relevant to low-carbon building materials.

Observation 3

The Committee encourages Canadian companies to diversify and innovate in order to provide the domestic market with energy-efficient building components and materials.

The Committee notes that the federal government is imposing energy efficiency standards for various energy-using products, including building components and systems, through regulations made under the *Energy Efficiency Act*. These regulations were last updated in 2016 to impose energy efficiency standards for, among other things, building systems such as air conditioners, heat pumps and water heaters.[42] Proposals for further additions to the regulations are currently being considered to impose new efficiency standards for energy-using products, including for building components and systems such as gas furnaces,[43] heat recovery ventilators[44] and portable air conditioners.[45]

f. Training to Support the Implementation of Updated Model Codes

Martin Luymes, Director of Programs and Relations of the Heating, Refrigeration and Air Conditioning Institute of Canada advised the Committee that, as codes and building systems become increasingly sophisticated, training for skilled labour transitioning will be required, to ensure that Canada has the personnel necessary to implement the codes.[46] Therefore:

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42 Natural Resources Canada, *Amendment 13*, December 2016.

43 Natural Resources Canada, *Amendment 14*, 18 April 2018.

44 Natural Resources Canada, *Amendment 15*, 4 March 2017.

45 Natural Resources Canada, *Amendment 16*, 4 March 2017.

46 ENVI, *Evidence*, 13 February 2018, 1150 (Martin Luymes, Director of Programs and Relations, Heating, Refrigeration and Air Conditioning Institute of Canada).

Recommendation 4

The Committee recommends that Employment and Social Development Canada ensure that programs exist or are established to address the labour transition required so that skilled personnel are available to implement net-zero energy ready codes.

Observation 4

The Committee encourages relevant trades institutions, such as the Heating, Refrigeration and Air Conditioning Institute of Canada, and building inspectors to prioritize training that will prepare personnel to implement net-zero energy ready codes and increasingly sophisticated building systems.

3. Energy Retrofitting of Canada's Existing Buildings

a. An Energy Retrofit Strategy

Thomas Mueller, President and Chief Executive Officer of the Canada Green Building Council, noted that his organization had developed a roadmap for retrofits in Canada with different strategies based on region, building age and type, electricity source, and heating fuel source.[47] Mr. Mueller identified an opportunity for the federal government to create regionally-targeted policies for retrofits, including to facilitate the transition to lower-emitting fuel sources. Consequently:

Recommendation 5

The Committee recommends that Natural Resources Canada, the National Research Council, and the Canada Mortgage and Housing Corporation work together to develop a national strategy for energy retrofits of existing buildings that reflects regional differences and targets the most effective emissions reduction opportunities.

The Canada Green Building Council also recommended to the Committee that the federal government accelerate progress in energy retrofitting by allocating $1 billion from the Canadian Infrastructure Bank for retrofits of commercial and multi-residential buildings in the public and private sectors.[48] To accelerate the energy retrofits of Canada's existing building stock:

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47 ENVI, *Evidence*, 13 February 2018, 1120 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

48 ENVI, *Evidence*, 13 February 2018, 1125 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

Recommendation 6

The Committee recommends that Infrastructure Canada work to provide significant funding in order to accelerate energy retrofits of commercial, institutional, and multi-residential buildings in the public and private sectors, such as through the Canada Infrastructure Bank.

b. Energy Retrofit Verification

Both Mr. Mueller and Mr. Luymes highlighted a gap in verification that building systems and retrofits deliver on their promised energy efficiency (and corresponding carbon emissions).[49] They suggested that federal leadership in this area could be helpful. Therefore:

Recommendation 7

The Committee recommends that Natural Resources Canada, in collaboration with the National Research Council and the Canada Mortgage and Housing Corporation, develop guidance and tools to support verification of the effectiveness of completed energy retrofits.

c. Considering Cultural Heritage Value and Embodied Carbon

In discussing the development of a model energy retrofit code for existing buildings, the Committee asked officials if existing buildings and, in particular, heritage buildings, would be expected to achieve the same net-zero standard as new builds. Ms. Stinson explained that it is not expected that existing buildings would get to net zero. Mr. DesRosiers clarified that, in the model energy retrofit code for existing buildings, there could be various tiers, including one for heritage buildings that could accommodate maintaining their heritage character.

Further to the consideration of heritage buildings, the Committee received briefs and heard testimony related to the built environment as part of its study of Bill C-323 An Act to amend the Income Tax Act (rehabilitation of historic property) and its study of Heritage Preservation and Protection in Canada. In his Heritage Preservation and Protection in Canada brief, Christophe Rivet of the Canadian Committee of the International Council on Monuments and on Sites (ICOMOS Canada) observed that the

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49 ENVI, *Evidence*, 13 February 2018, 1125 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council); and ENVI, *Evidence*, 13 February 2018, 1250 (Martin Luymes, Director of Programs and Relations, Heating, Refrigeration and Air Conditioning Institute of Canada).

goals of funding programmes to encourage heritage building conservation may sometimes be at odds with the goals of funding programmes to encourage energy efficiency in buildings.

In his testimony during the Heritage Preservation and Protection in Canada study, Robert Eisenberg provided an example of conflicting heritage conservation and energy efficiency goals, whereby adding a green roof to a heritage building may surpass the weight that the roof was originally designed to support. Likewise, if insulation is added to a heritage building roof, the accumulation of snow load can exceed the roof's weight capacity because heat loss no longer melts the snow.[50] As a solution, Dr. Rivet recommended that the Government of Canada integrate the goals of heritage conservation and energy efficiency funding programmes, such as including criteria for cultural heritage conservation in funding programmes for energy efficiency and infrastructure.[51]

In their joint brief regarding Bill C-323, the Heritage Foundation of Newfoundland and Labrador, Newfoundland Historic Trust, and Association of Heritage Industries, NL noted:

> Another cost that should be factored into supporting preservation and adaptive reuse is the environmental one. Existing buildings contain the embodied energy used to construct them (materials, transportation and building costs) which are lost if a building is destroyed. Additional CO_2 emissions are created when a new building is constructed in its place. Supporting greater adaptive reuse of our existing building stock will help Canada to meet its commitment to reduce CO_2 emissions under the Paris Accord.

In his testimony during the study on Heritage Preservation and Protection in Canada, Mr. David Brown of the National Trust for Historic Preservation noted the importance of the embedded energy and carbon in older buildings and the importance of considering the environmental consequences of demolishing and landfilling buildings.

Similarly, in his written submission to the Committee, Mr. Chris Wiebe of the National Trust for Canada expressed that:

> The greenest building is the one already standing, because its reuse capitalizes on resources already expended and avoids the carbon generated by new construction, including the processing and transportation of new materials.[52]

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50 ENVI, *Evidence*, 3 October 2018, 1535 (Robert Eisenberg, Partner, York Heritage Properties).

51 Christophe Rivet (President, Canadian Committee of the International Council on Monuments and on Sites), Brief Submitted to the House of Commons Standing Committee on Environment and Sustainable Development Concerning Heritage Preservation and Protection in Canada, 4 November 2017.

52 Chris Wiebe (National Trust for Canada), Written Correspondence Submitted to the House of Commons Standing Committee on Environment and Sustainable Development Concerning Clean Growth and Climate Change in Canada: Built Environment, 15 January 2018.

Mr. Wiebe also noted ongoing work on the cost-benefit analysis of retaining rather than demolishing existing buildings, such as the assessment of life cycle environmental impacts of construction material and assemblies conducted by the Athena Sustainable Materials Institute. This research collaborative provides guidance and free software to calculate embodied carbon, or lifetime GHG emissions due to a residential or commercial building other than for its operation (i.e. material manufacturing).[53]

Mr. Hill from the Canada Mortgage Housing Corporation (CMHC) offered a different perspective regarding life cycle energy use and impacts of buildings. He noted that CMHC has conducted studies of life cycle environmental impacts of highly energy-efficient buildings, and is aware of the significant environmental impacts from material extraction, transportation, and construction, as well as upgrading building systems such as furnaces. However, CMHC found that, over the life cycle of a building, the impacts of operating energy typically far outweigh that of the building materials. Mr. Hill is of the opinion that the current focus on lowering operating costs (i.e. energy usage) is appropriate, including for existing buildings.[54]

The Committee finds it important to consider embodied carbon, heritage construction characteristics, and cultural heritage value when making decisions about renovating or replacing existing buildings to achieve improved energy efficiency. Therefore:

Recommendation 8

The Committee recommends that the federal government create or adopt a measurement tool to take into account the net carbon emissions avoided through adaptive reuse of existing buildings.

Recommendation 9

The Committee recommends that, as the federal government takes steps to recognize the value of embedded carbon in existing construction, it should take into account the unique characteristics of heritage buildings and the public interest in their protection.

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53 Athena Sustainable Material Institute, "The Athena Institute believes a life cycle perspective is required for sustainability," *The Athena Institute envisions a built environment made more sustainable through data.*

54 ENVI. *Evidence*, 8 February 2018, 1215 (Duncan Hill, Manager, Housing Needs Research, Canada Mortgage and Housing Corporation).

4. Voluntary Building Standards: Raising the Bar for Efficiency

The Committee heard from numerous witnesses that voluntary building certifications and standards are effective at driving building efficiency.[55] Voluntary industry standards (e.g. LEED, BOMA BEST, Passive House) have played an important role in delivering buildings above code, informing more ambitious national codes, and fostering industry leadership in continuous efficiency improvement.[56] Because the building code takes years between development and taking effect in the marketplace, Mr. Mueller noted that voluntary systems can be more effective at accelerating efficiency improvements.[57] Both Mr. Froebelius of the Building Owners and Managers Association (BOMA) and Mr. Mueller of Canada Green Building Council observed that the good return on investment of sustainable buildings, due to their lower operational costs, drives commercial real estate investors to demand buildings built to voluntary standards.[58]

Rob Bernhardt, Chief Executive Officer of Passive House Canada informed the Committee that Passive House architects, engineers, contractors, developers and manufacturers are today delivering buildings that meet the level of efficiency that is targeted in the 2030 net-zero energy ready national model building code.[59] Mr. Berhhardt cited an economic 'sweet spot' where increasing efficiency results in decreased costs due to a simplified design and a building envelope so efficient that high-power mechanical systems are not required to maintain a comfortable environment. Passive House provides a national curriculum to train engineers and builders on these principles.[60]

Officials from BOMA explained that buildings are becoming increasingly complex and managed by IT systems. As a result, they believe one should not stop considering efficiency after having designed a green building, but instead should continue to

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55 ENVI, *Evidence*, 13 February 2018, 1115 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council); ENVI, *Evidence*, 8 February 2018, 1125 (Rob Bernhardt, Chief Executive Officer, Passive House Canada); ENVI, *Evidence*, 8 February 2018, 1120 (Benjamin Shinewald, President and Chief Executive Officer, Building Owners and Managers Association of Canada).

56 ENVI, *Evidence*, 13 February 2018, 1115 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

57 ENVI, *Evidence*, 13 February 2018, 1115 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

58 ENVI, *Evidence*, 8 February 2018, 1155 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International); ENVI, *Evidence*, 13 February 2018, 1255 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

59 ENVI, *Evidence*, 8 February 2018, 1125 (Rob Bernhardt, Chief Executive Officer, Passive House Canada).

60 ENVI, *Evidence*, 8 February 2018, 1125 (Rob Bernhardt, Chief Executive Officer, Passive House Canada).

consider efficiency in its operations.[61] The BOMA BEST (Building Environmental Standards) certification is applied to existing buildings, involves operator training, and its core objective is the continuous improvement of building operation and maintenance.[62]

Mr. Froebelius noted that once a building is designed, constructed, and handed over to the owner/operator, the people actually running the building systems must be aware of how the building's features can be optimized for efficiency.[63] If those operating the building systems are not fully aware of how to make the most of their efficiency features, the investment and effort of green design is partly lost. As Mr. Froebelius explained, "Property managers and building operators have market-based incentives to operate their buildings efficiently, which means energy, water, and waste efficiency too. Therefore, invest in the human beings running our built environment."[64] Mr. Froebelius advised that the federal government include staff training as an aspect of NRCan or CMHC's energy-efficient building research.[65] In recognition of the importance of building operator and inspector training:

Recommendation 10

The Committee recommends that Natural Resources Canada, the National Research Council, and Environment and Climate Change Canada include building operator and building inspector training as part of federal funding, research, and incentive programs aimed at improving energy efficiency and reducing greenhouse gas emissions from the built environment.

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61 ENVI, *Evidence*, 8 February 2018, 1125 (Benjamin Shinewald, President and Chief Executive Officer, Building Owners and Managers Association of Canada).

62 ENVI, *Evidence*, 8 February 2018, 1120 (Benjamin Shinewald, President and Chief Executive Officer, Building Owners and Managers Association of Canada) and About BOMA BEST.

63 ENVI, *Evidence*, 8 February 2018, 1115 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International).

64 ENVI, *Evidence*, 8 February 2018, 1115 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International).

65 ENVI, *Evidence*, 8 February 2018, 1135 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International).

5. Ensuring Canadians Have the Information to Make Smart Building Decisions

A number of witnesses mentioned the importance of increasing consumer awareness regarding energy-efficient options.[66] Many Canadians are not fully aware that they can save money over the long term, improve building comfort, and reduce GHG emissions through their building purchase and renovation decisions.[67] Various witnesses mentioned the importance of considering the stored carbon or embodied energy in existing buildings and not simply the energy efficiency of new buildings.[68]

Mr. Luymes informed the Committee about a study conducted by the Canadian Energy Efficiency Alliance which showed that Canadians want to do more to fight climate change at home but they don't know where to start. He suggested that there is a potentially powerful role for the federal government in providing science-based information and fully deploying programs like the EnerGuide rating system for homes.[69] Mr. Mannani also recommended that the federal government support mandatory energy labelling and energy modelling for both new and resale buildings, in order to inform consumer decisions.[70]

The Committee is encouraged that, in the Pan-Canadian Framework, the federal government committed to work with provinces and territories to require mandatory building energy labelling by as early as 2019.[71] The Committee notes that the NRCan website showcases the benefits of EnerGuide energy efficiency home evaluations[72] and

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66 ENVI, *Evidence*, 6 February 2018, 1215 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources), ENVI. *Evidence*, 8 February 2018, 1230 (Rob Bernhardt, Chief Executive Officer, Passive House Canada), ENVI, *Evidence*, 13 February 2018, 1105 (Bijan Mannani, President, Landmark Homes Canada), ENVI, *Evidence*, 13 February 2018, 1235 (Martin Luymes, Director of Programs and Relations, Heating, Refrigeration and Air Conditioning Institute of Canada).

67 ENVI, *Evidence*, 8 February 2018, 1130 and 1230 (Rob Bernhardt, Chief Executive Officer, Passive House Canada).

68 ENVI, *Evidence*, 8 February 2018 (Rob Bernhardt, Chief Executive Officer, Passive House Canada), ENVI, *Evidence*, 13 February 2018, 1125 (Michael Giroux, President, Canadian Wood Council), ENVI, *Evidence*, 13 February 2018, 1205 (Adam Auer, Vice-President, Environment and Sustainability, Cement Association of Canada).

69 ENVI, *Evidence*, 13 February 2018, 1235 (Martin Luymes, Director of Programs and Relations, Heating, Refrigeration and Air Conditioning Institute of Canada).

70 ENVI, *Evidence*, 13 February 2018m 1105 (Bijan Mannani, President, Landmark Homes Canada).

71 Governments of Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Alberta, British Columbia, Yukon, Northwest Territories, Nunavut, and Canada. 2016. *Pan-Canadian Framework on Clean Growth and Climate Change*.

72 Natural Resources Canada, *EnerGuide energy efficiency home evaluations*.

provides consumer information on buying ENERGY STAR, R-2000, EnerGuide, or Net-Zero-rated homes.[73] To further inform Canadians:

Recommendation 11

The Committee recommends that Natural Resources Canada, in collaboration with the National Research Council, invest in methods (e.g. apps, web-based programs) through which building and home owners can obtain easily-understood information about their estimated energy usage and carbon emissions, and to compare the economic and emissions impacts of various energy-efficiency retrofits.

During the Committee's travel to inform its overall study on Clean Growth and Climate Change in Canada, on 13 March 2018 the Committee heard from Dick Ebersohn and Brit Samborsky from the City of Calgary. Misters Ebersohn and Samborsky noted an opportunity to leverage realtors to communicate energy labelling information to potential buyers. The representatives suggested that energy labelling information could be required to be included in realtor descriptions of buildings for sale. As a result:

Observation 5

The Committee encourages provinces and territories to require the inclusion of building energy labelling information in real estate listings, to promote consumer awareness of energy-efficient building practices.

6. National Leadership through Research and Strategic Incentives

a. Research

The Committee notes that the federal government is uniquely positioned with the facilities and capacity to support research, development and the demonstration of innovative technologies and approaches. This important work, done in collaboration with industry, reduces the risk of adopting newer technologies by demonstrating their use in various conditions.[74] Mr. DesRosiers indicated that NRCan undertakes research

73 Natural Resources Canada, *Buying an energy-efficient new home*.

74 ENVI, *Evidence*, 6 February 2018, 1130 (Richard Tremblay, Director General, Construction, National Research Council of Canada).

specifically to try to reduce the cost of a new technology, for example, aiming to reduce the cost of geothermal heating units by half.[75]

The Committee heard about the value of federal research to builders from Bijan Mannani, President of Landmark Homes Canada, which constructs net-zero energy ready homes in Alberta. Landmark homes has reduced GHG emissions and material waste from their building processes through offsite construction of sections of homes which are then quickly assembled on site.[76] Mr. Mannani requested that the federal government further invest in research and development and demonstration in building science, particularly around the building envelope, windows, and heating, ventilation, and air-conditioning systems (HVAC).[77] In order to further support net-zero energy ready builders, particularly related to the building envelope, windows, and heating, ventilation, and air-conditioning systems:

Recommendation 12

The Committee recommends that the federal government further invest in research, development, and demonstration in building science.

b. Incentives

The federal government is well positioned to encourage consumer decisions in favour of highly energy-efficient buildings by supporting incentive programs. Vincent Ngan, Director General, Horizontal Policy Engagement & Coordination, Department of the Environment informed the Committee that, in June 2017, the federal government "announced a leadership fund for the low-carbon economy, and then in December ... announced, with six provinces, [its] plan to partner [with] them in supporting the energy retrofit program. They include Nova Scotia, British Columbia, Alberta, Ontario, and New Brunswick. [The government is] providing support for their retrofit energy efficiency programs, to make some of these retrofit changes more affordable, and to create jobs that are supporting innovation and clean growth."[78]

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75 ENVI, *Evidence*, 6 February 2018, 1230 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

76 ENVI, *Evidence*, 13 February 2018, 1110 (Bijan Mannani, President, Landmark Homes Canada).

77 ENVI, *Evidence*, 13 February 2018, 1105 (Bijan Mannani, President, Landmark Homes Canada).

78 ENVI, *Evidence*, 6 February 2018, 1145 (Vincent Ngan, Director General, Horizontal Policy Engagement & Coordination, Department of the Environment).

Duncan Hill described the way the CMHC has incentivized green housing through its funding programs. CMHC provides a premium refund on mortgage loan insurance of up to 25% to borrow to buy, build or renovate for energy efficiency with its Green Home program.[79] Since the Green Home Program's inception in 2012, owners of 4,295 single homes and 181 multi-unit buildings (containing 17,446 individual dwellings) have taken advantage of the incentive.[80] When asked how consumers become aware of the Green Home program, Mr. Hill replied that CMHC largely works through the mortgage loan insurance and lending industries to communicate the program to buyers and renovators at the point of financing. Mr. Hill also made reference to a 2017-18 government initiative to increase awareness of energy-efficient building incentives prior to the point of financing.[81] The Committee identifies an opportunity to further encourage current and prospective homeowners to make energy-efficient choices. As a result:

Recommendation 13

The Committee recommends that the Canada Mortgage and Housing Corporation work with its partners to more broadly promote the incentives available for buying, building, and renovating energy-efficient homes, prior to the point of financing.

Mr. Hill also explained that the CMHC is leading the implementation of the new national housing strategy, which will create 100,000 new affordable housing units and retrofit another 300,000 existing units to be more energy efficient. The national housing strategy will encourage housing innovation through the funding of research, the creation of solution labs to enable industry research, and the demonstration of affordable housing projects which are energy-efficient and produce fewer greenhouse gas emissions. Funding will also be provided to retrofit surplus federal buildings into sustainable affordable housing.[82]

Representatives from the BOMA offered recommendations for how to best focus federal incentives. Mr. Froebelius of BOMA observed that building owners generally undertake a retrofit without an incentive if it will result in a "three year payback" of the investment

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79 ENVI, *Evidence*, 8 February 2018, 1105 (Duncan Hill, Manager, Housing Needs Research, Canada Mortgage and Housing Corporation).

80 Canada Mortgage and Housing Corporation. Written Response regarding ENVI Meeting no. 094 on 8 February 2018.

81 ENVI, *Evidence*, 8 February 2018, 1225 (Duncan Hill, Manager, Housing Needs Research, Canada Mortgage and Housing Corporation).

82 ENVI, *Evidence*, 8 February 2018, 1105 (Duncan Hill, Manager, Housing Needs Research, Canada Mortgage and Housing Corporation).

or in "15% lower operating costs". As a result, he recommended that the federal government focus on incentivizing retrofits that fail to reach these thresholds.[83] Mr. Froebelius suggested that the federal government support energy efficiency in commercial buildings through ongoing technology training for the people operating and maintaining buildings. He noted that this could be accomplished by having training as a component of retrofit incentives.[84] Benjamin Shinewald of BOMA suggested that the federal government help incentivize on-site renewable energy generation,[85] particularly in regions where the energy grid is less clean.[86]

The Committee heard from several witnesses who mentioned that the regulatory environment for clean technology and onsite renewable energy generation, can discourage their adoption, for example, through high permitting costs.[87] From his perspective as a custom home builder, Mr. Hewitt offered recommendations for federal incentives. He suggested that the federal government consider a federally-backed mortgage rate reduction to offset the extra construction costs of net-zero or passive homes, in order to increase market uptake.[88] He also endorsed the notion of a tax credit for onsite renewable installations, as has been a successful incentive in the U.S. for solar panels.[89]

Mr. Froebelius also observed "...the many new technologies that are on the cusp: air-source heat pumps, advances to ground-source heat pumps, and a lot of condensation or condensing-type boiler systems, etc. ... people are worried that if they adopt those systems, insurance companies will still insist that there's a backup of a more traditional system." The Committee notes that incentives could be used to reduce the

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83 ENVI, *Evidence*, 8 February 2018, 1120 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International).

84 ENVI, *Evidence*, 8 February 2018, 1135 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International).

85 Natural Resources Canada notes that renewable energy includes that generated from solar, wind, geothermal, hydropower and ocean resources, solid biomass, biogas and liquid biofuels. Natural Resources Canada, *Renewable Electricity*.

86 ENVI, *Evidence*, 8 February 2018, 1120 (Benjamin Shinewald, President and Chief Executive Officer, Building Owners and Managers Association of Canada).

87 ENVI, *Evidence*, 8 February 2018, 1210 (Rob Bernhardt, Chief Executive Officer, Passive House Canada); ENVI, *Evidence*, 15 February 2018, 1215 (Thomas Hewitt, President, Netzero Construction).

88 ENVI, *Evidence*, 15 February 2018, 1130 (Thomas Hewitt, President, Netzero Construction).

89 ENVI, *Evidence*, 15 February 2018, 1130 (Thomas Hewitt, President, Netzero Construction).

risk of emerging sustainable technologies to early adopters and to encourage insurance providers not to require traditional systems as a backup.[90]

To increase the market uptake of onsite renewable energy generation and net-zero energy ready building techniques and technologies:

Recommendation 14

The Committee recommends that Natural Resources Canada and the National Research Council work with, and encourage, provincial/territorial, municipal, and industry partners to streamline the regulatory environment in order to encourage the early adoption of onsite renewable energy generation and green building techniques and technologies.

Recommendation 15

The Committee recommends that Natural Resources Canada, Finance Canada, Infrastructure Canada, and the Canada Mortgage and Housing Corporation identify and implement effective financial incentives to encourage on-site renewable energy generation and net-zero energy ready building construction (e.g. a federally-backed mortgage rate reduction, Canada Infrastructure Bank funding, insurance incentives, or programs similar to the U.S. renewable energy tax credits or U.S. tax credits for home builders).

7. Leveraging Federal Real Property Management and Procurement to Promote Building Efficiency

When discussing how the federal government leads by example through its own buildings, Mr. DesRosiers reminded the Committee of the Greening Government Strategy, which applies to federal buildings and operations. The Greening Government Strategy sets the ambitious target to reduce GHG emissions from federal operations by 40% by 2030 – more ambitious than the target for Canada as a whole. The Strategy is managed out of Centre for Greening Government at the Treasury Board of Canada Secretariat.[91] Given the extent of the federal government's building ownership and operations, and the considerable potential positive impacts of the Greening Government Strategy:

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90 ENVI, *Evidence*, 8 February 2018, 1140 (Randal Froebelius, President and General Manager, Equity ICI Real Estate Services Inc., Building Owners and Managers Association International).

91 ENVI, *Evidence*, 6 February 2018, 1150 (Frank DesRosiers, Assistant Deputy Minister, Innovation and Energy Technology Sector, Department of Natural Resources).

Recommendation 16

The Committee requests that the federal government focus more attention on its Greening Government Strategy and report back to the Committee on its progress by the end of 2018.

A number of witnesses were of the opinion that the federal government could further leverage its portfolio of owned and rented buildings, and its procurement processes, to support energy-efficient building standards and innovations. Mr. Mueller explained the positive impact that governments can have by being early adopters of emerging standards, approaches, and technologies. He stated that the federal government and some municipalities had de-risked the adoption of LEED for the private sector by demonstrating its feasibility and benefits on some of their buildings.[92] Mr. Mueller and Mr. Shinewald called on the federal government to exercise its leadership potential as the largest real property owner in the country and demand higher environmental standards for all federal buildings.[93] Both witnesses encouraged the federal government to continue to support voluntary industry standards, such as LEED and BOMA BEST, through its procurement policies. Mr. Mueller recommended that the federal government consider requiring more stringent voluntary industry standards, such as LEED Platinum.[94]

Mr. Shinewald suggested that the federal government leverage its market leadership potential as a major building leaser, to require highly energy-efficient standards for its rental space (with the added benefit of saving tax dollars in operational costs).[95] Mr. Mueller also called on the federal government to invest in the retrofit economy by requiring all custodian departments and agencies to develop multi-year retrofit strategies for their portfolios of buildings.[96]

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92 ENVI, *Evidence*, 13 February 2018, 1200 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

93 ENVI, *Evidence*, 8 February 2018, 1155 (Benjamin Shinewald, President and Chief Executive Officer, Building Owners and Managers Association of Canada); ENVI, *Evidence*, 13 February 2018, 1115 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

94 ENVI, *Evidence*, 13 February 2018, 1115 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

95 ENVI, *Evidence*, 8 February 2018, 1155 (Benjamin Shinewald, President and Chief Executive Officer, Building Owners and Managers Association of Canada).

96 ENVI, *Evidence*, 13 February 2018, 1125 (Thomas Mueller, President and Chief Executive Officer, Canada Green Building Council).

In order to further encourage the market shift in commercial buildings towards high environmental performance:

Recommendation 17

The Committee recommends that Public Services and Procurement Canada and the Treasury Board of Canada Secretariat work with all other federal departments and agencies to demand higher energy efficiency standards (e.g. LEED, BOMA BEST) when procuring rental space and new buildings.

Recommendation 18

The Committee recommends that Public Services and Procurement Canada and the Treasury Board of Canada Secretariat require all federal custodian departments and agencies to develop and implement multi-year energy retrofit strategies for their respective portfolios of existing federally-owned buildings.

Regarding federal government purchasing, Mr. McSweeney suggested that the federal government leverage its substantial purchasing power and require the consideration of climate change mitigation and GHG emissions in procurement, and not just the lowest cost, without being prescriptive as to the particular material.[97] Mr. McSweeney also requested that the federal government mandate the use of full life cycle analyses for all federally funded infrastructure projects.[98] The Committee reflected that this approach would provide a more complete analysis of the carbon and cost implications throughout the phases of material sourcing, construction, operation, decommissioning, and potential replacement of buildings and infrastructure. As such:

Recommendation 19

The Committee recommends that the federal government, when making federal infrastructure procurement decisions, consider including full life cycle analyses that address carbon emissions and storage resulting from the infrastructure's materials, construction, operation, and de-commissioning.

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97 ENVI, *Evidence*, 13 February 2018, 1135 (Michael McSweeney, President and Chief Executive Officer, Cement Association of Canada).

98 ENVI, *Evidence*, 13 February 2018, 1140 (Michael McSweeney, President and Chief Executive Officer, Cement Association of Canada).

8. An Energy-Efficient Building Strategy for Canada's North

Alain Fournier, Architect and Founding Partner of EVOQ Architecture, spoke to the Committee about his experience designing and building highly energy-efficient buildings in the Canadian Arctic. He advised that, due to the climate and supply isolation, net-zero or passive house standards may never be feasible in the Arctic.[99] However, he noted that improvements can still be made in the North and advised to focus on increasing building energy efficiency through improved building envelopes that consist of permanent, low-tech, heavy-duty, durable materials.[100] Mr. Fournier further explained that shipping costs and the lack of available maintenance infrastructure, parts, and personnel, make the use of many energy-efficient technologies in the Arctic impractical.[101] Gary Wong, Director of Infrastructure for the Nunavut Housing Corporation on challenges related to energy-efficient housing in the Arctic, agreed with Mr. Fournier that it may be unrealistic for net-zero energy ready building codes implemented in this region due to its unique circumstances and capacity.[102]

Mr. Wong explained that building energy efficiency has had to be relatively high in the Arctic to deal with the cold climate. He suggested that perhaps a more significant way to decrease the carbon footprint in Nunavut is to target electricity generation, which is generally from diesel. Mr. Wong does not foresee diesel energy generation being eliminated for isolated Arctic communities as it provides the most secure and reliable form of energy, which is a health and safety concern. However, he noted that many of these diesel energy generators are decades old and inefficient, resulting in greater diesel and maintenance costs as well as emissions.[103]

Mr. Wong suggested that the federal government increase its research, development, and demonstration of northern building approaches and materials, and that, in order to reduce costs, more of this testing be in a lab setting in the south, instead of necessarily

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99 ENVI, *Evidence*, 15 February 2018, 1230 (Alain Fournier, Architect, Founding Partner, EVOQ Architecture).

100 ENVI, *Evidence*, 15 February 2018, 1115 and 1210 (Alain Fournier, Architect, Founding Partner, EVOQ Architecture).

101 ENVI, *Evidence*, 15 February 2018, 1230 (Alain Fournier, Architect, Founding Partner, EVOQ Architecture).

102 ENVI, *Evidence*, 15 February 2018, 1140 (Gary Wong, Director of Infrastructure, Nunavut Housing Corporation).

103 ENVI, *Evidence*, 15 February 2018, 1105 (Gary Wong, Director of Infrastructure, Nunavut Housing Corporation). Note: These issues are further discussed in the Standing Senate Committee on Energy, the Environment and Natural Resources' 2015 report, *Powering Canada's Territories*.

conducting northern pilot projects where follow-up monitoring personnel is scarce.[104] Mr. Fournier further recommended that the federal government support industry research and development for remote northern communities, where there may not be a market incentive for industry to do this work on their own.[105] He also suggested that the federal government support post-construction monitoring and documentation of northern building and infrastructure projects, in order to ascertain and share best design and construction practices (as there is often no funding left in a contract for this).[106]

The Committee recognizes the unique challenges of the Arctic and recommends that northern jurisdictions not be expected to adopt the same net-zero energy ready national model code as southern Canada. The Committee rather suggests that the federal government work with the territorial governments to develop "Made in the North" solutions for reducing GHG emissions from the building sector. Therefore:

Recommendation 20

The Committee recommends that Natural Resources Canada and the National Research Council work with Indigenous governments and communities, territorial and affected provincial governments, and industry to invest in building science and clean energy generation research, development, demonstration, and post-construction monitoring in the Canadian North.

Recommendation 21

The Committee recommends that Natural Resources Canada and the National Research Council work with Indigenous governments and communities and territorial and affected provincial governments to develop building standards specifically adapted to the Canadian North.

C. CONCLUSION

The Committee recognizes the significant progress made by the federal government in furthering building science research and supporting the development of more stringent national model codes. The Committee commends the green building industry and related associations for their leadership in improving energy efficiency standards and practices in Canada.

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104 ENVI, *Evidence*, 15 February 2018, 1115 (Gary Wong, Director of Infrastructure, Nunavut Housing Corporation).

105 ENVI, *Evidence*, 15 February 2018, 1120 (Alain Fournier, Architect, Founding Partner, EVOQ Architecture).

106 ENVI, *Evidence*, 15 February 2018, 1120 (Alain Fournier, Architect, Founding Partner, EVOQ Architecture).

The Committee was impressed by the high level of collaboration and cooperation between federal, provincial, and territorial governments, industry associations, and builders, and looks forward to continued improvement in building energy efficiency and GHG emissions reduction. The Committee recommendations found in this report, if implemented, would further improve and accelerate the transformation to a more energy-efficient built environment in Canada.

APPENDIX A
LIST OF WITNESSES

Organizations and Individuals	Date	Meeting
Department of Natural Resources	2018/02/06	93
Frank Des Rosiers, Assistant Deputy Minister Innovation and Energy Technology Sector		
Sarah Stinson, Director Buildings and Industry Division, Office of Energy Efficiency, Energy Sector		
Department of the Environment		
Vincent Ngan, Director General Horizontal Policy Engagement & Coordination		
National Research Council of Canada		
Philip Rizcallah, Director Building Regulations		
Richard Tremblay, Director General, Construction		
Building Owners and Managers Association International	2018/02/08	94
Randal Froebelius, President and General Manager Equity ICI Real Estate Services Inc.		
Building Owners and Managers Association of Canada		
Benjamin Shinewald, President and Chief Executive Officer		
Canada Mortgage and Housing Corporation		
Duncan Hill, Manager Housing Needs Research		
Passive House Canada		
Rob Bernhardt, Chief Executive Officer		
Canada Green Building Council	2018/02/13	95
Thomas Mueller, President and Chief Executive Officer		
Canadian Wood Council		
Michael Giroux, President		

Organizations and Individuals	Date	Meeting
Cement Association of Canada	2018/02/13	95
Adam Auer, Vice-President Environment & Sustainability		
Michael McSweeney, President and Chief Executive Officer		
Heating, Refrigeration and Air Conditioning Institute of Canada		
Martin Luymes, Director of Programs and Relations		
Landmark Homes Canada		
Bijan Mannani, President		
Haitao Yu, Lead Researcher		
EVOQ Architecture	2018/02/15	96
Alain Fournier, Architect, Founding Partner		
Netzero Construction		
Thomas Hewitt, President		
Nunavut Housing Corporation		
Gary Wong, Director of Infrastructure		

APPENDIX B
LIST OF BRIEFS

Organizations and Individuals

Royal Architectural Institute of Canada

REQUEST FOR GOVERNMENT RESPONSE

Pursuant to Standing Order 109, the Committee requests that the government table a comprehensive response to this Report.

A copy of the relevant *Minutes of Proceedings* (Meetings Nos. 93, 94, 95, 96, 115, 116, 119, 120) is tabled.

Respectfully submitted,

Deborah Schulte
Chair